LIVING WITH GLACIERS

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Adapting to Climate change

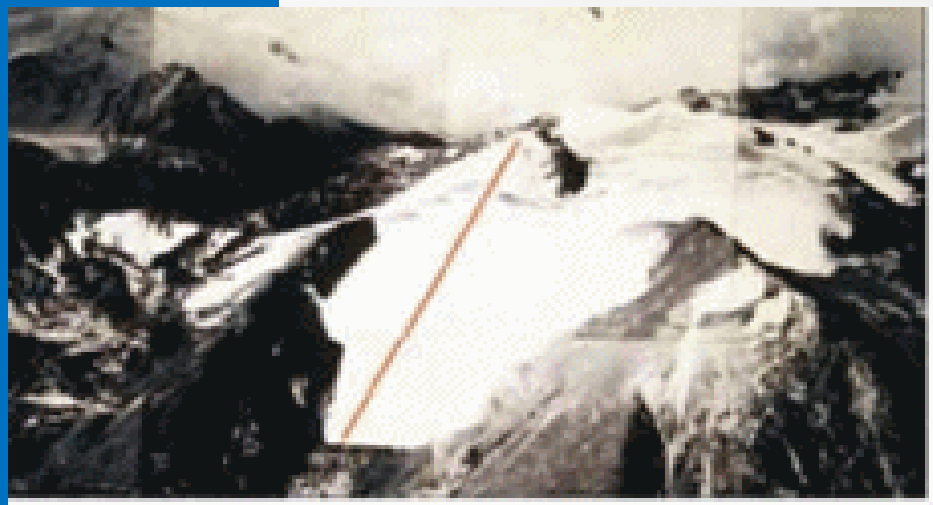
The experience of the Illimani project in Bolivia

Juan Carlos Alurralde, Paula Pacheco, Magali Garcia, Edson Ramirez, Danitza Salazar, Richard M... Proyecto Illimani
UMSA-IDRC

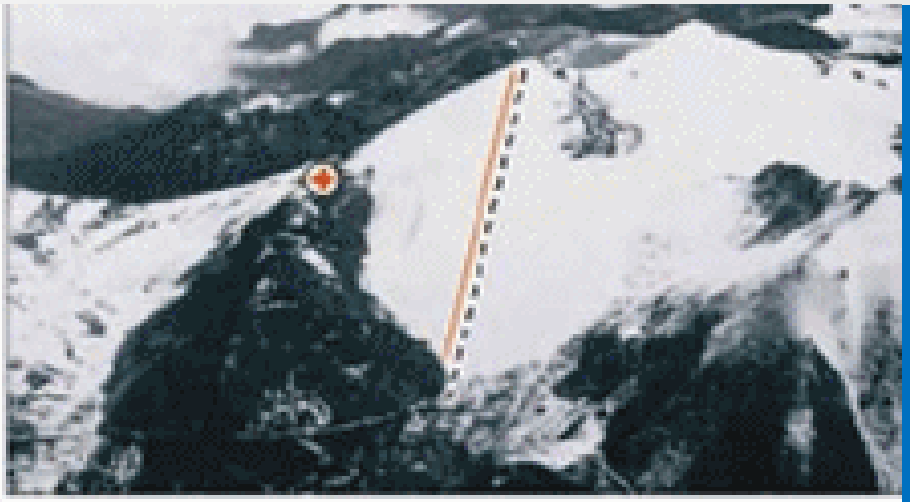
OBJECTIVE OF THE STUDY

To study the glacier dependent area of the Illimani glacier in a physical and socio/productive context to generate technically, socially and participative accepted adaptation strategy for climate change and climate variability effects that contribute to public policies at a local, national and international level

Motivation for research



1940 0.22 km²



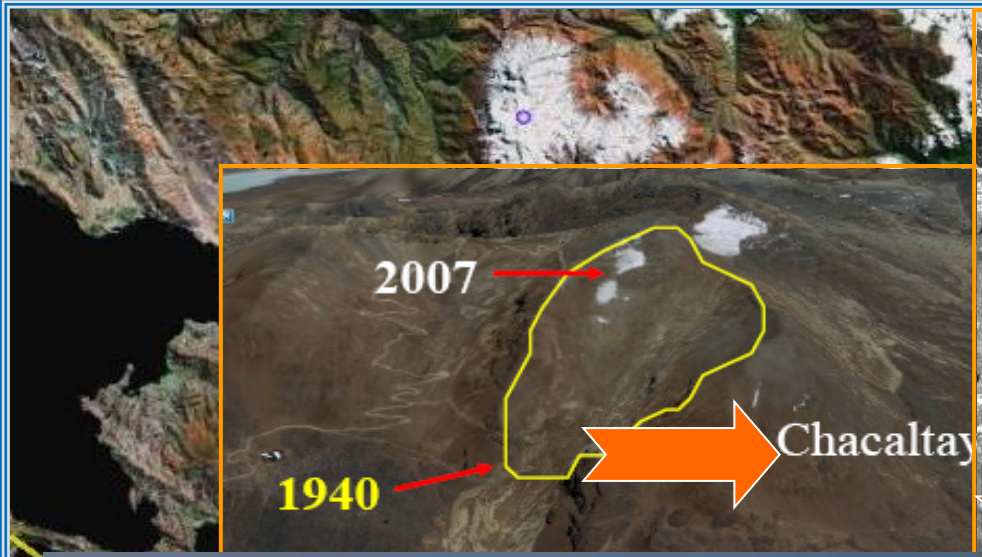
1982 0.14 km²

1996 0.08 km²

2005 0.01 km²

CHACALTAYA

Climate change impacts in glaciers of the Cordillera Real de Bolivia

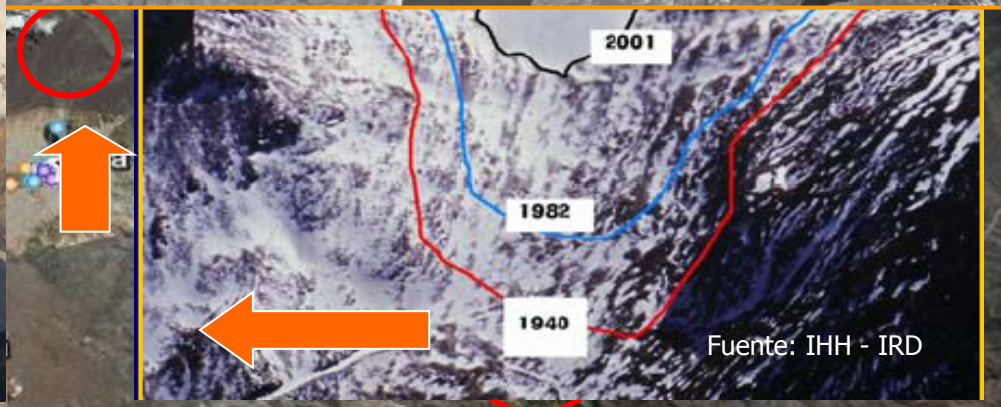



Fuente:http://upload.wikimedia.org/wikipedia/commons/5/53/Huayna_Potosi_2006.JPG

2000

Fuente: IHH - IRD


Fuente: http://static.panoramio.com/photos/original/1887191.jpg

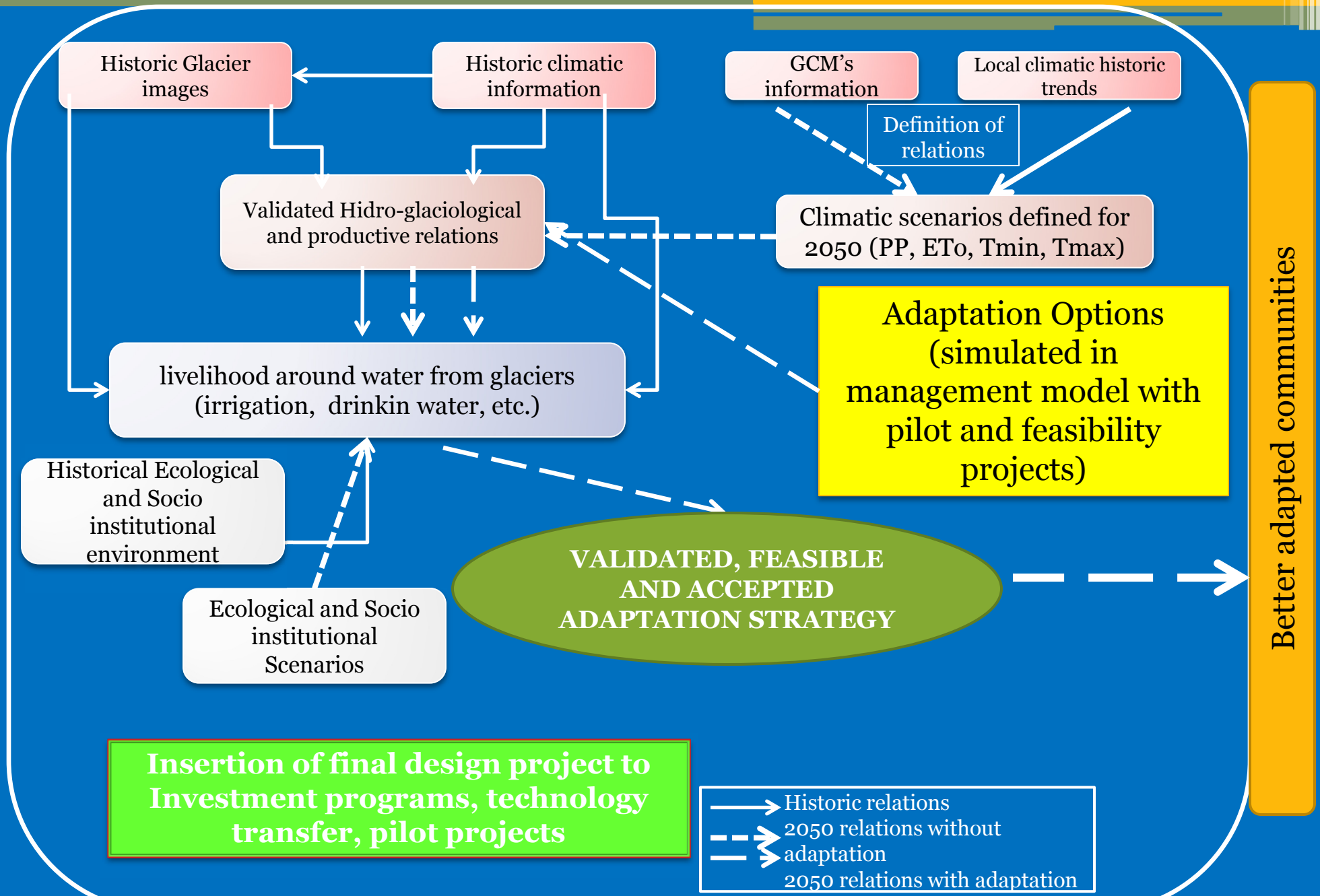


Fuente: IHH - IRD

Fuente: Google Earth (2008)

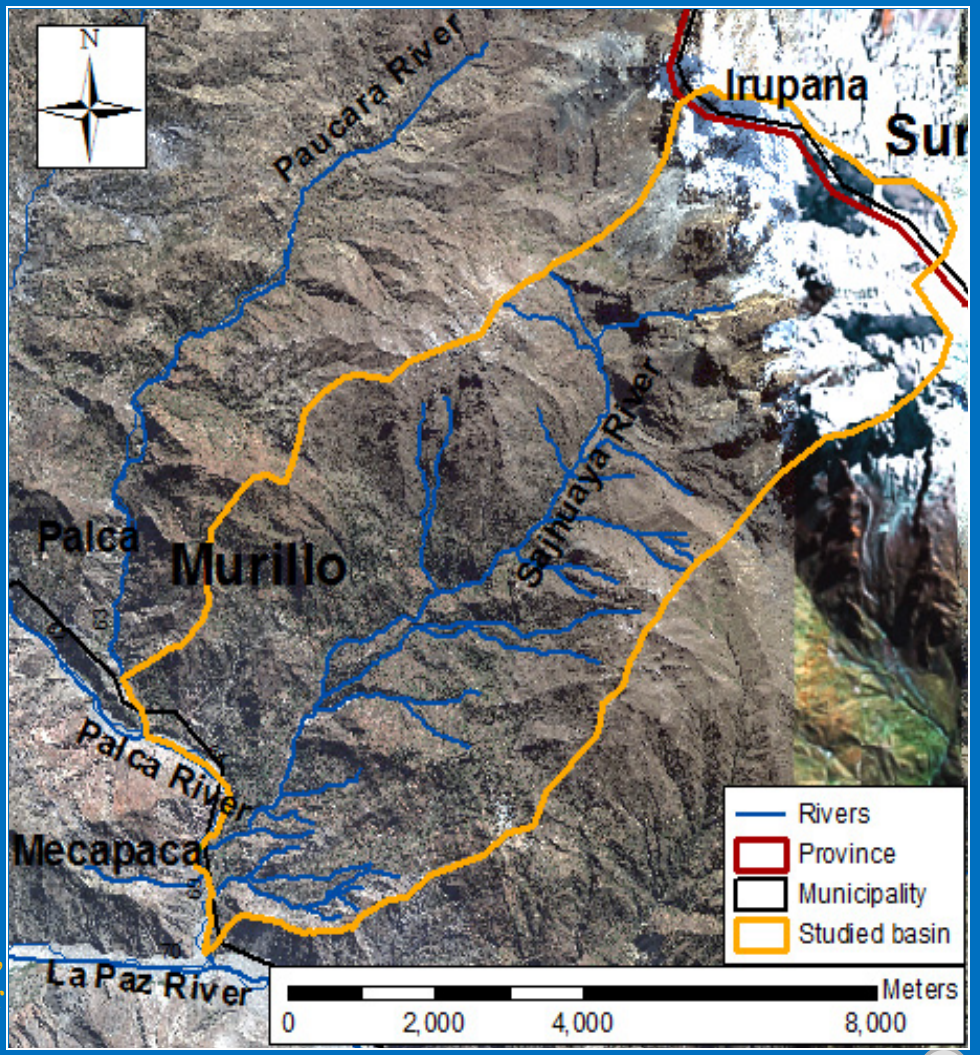
Cracks in the glacier(2008)

INTEGRATED APPROACH

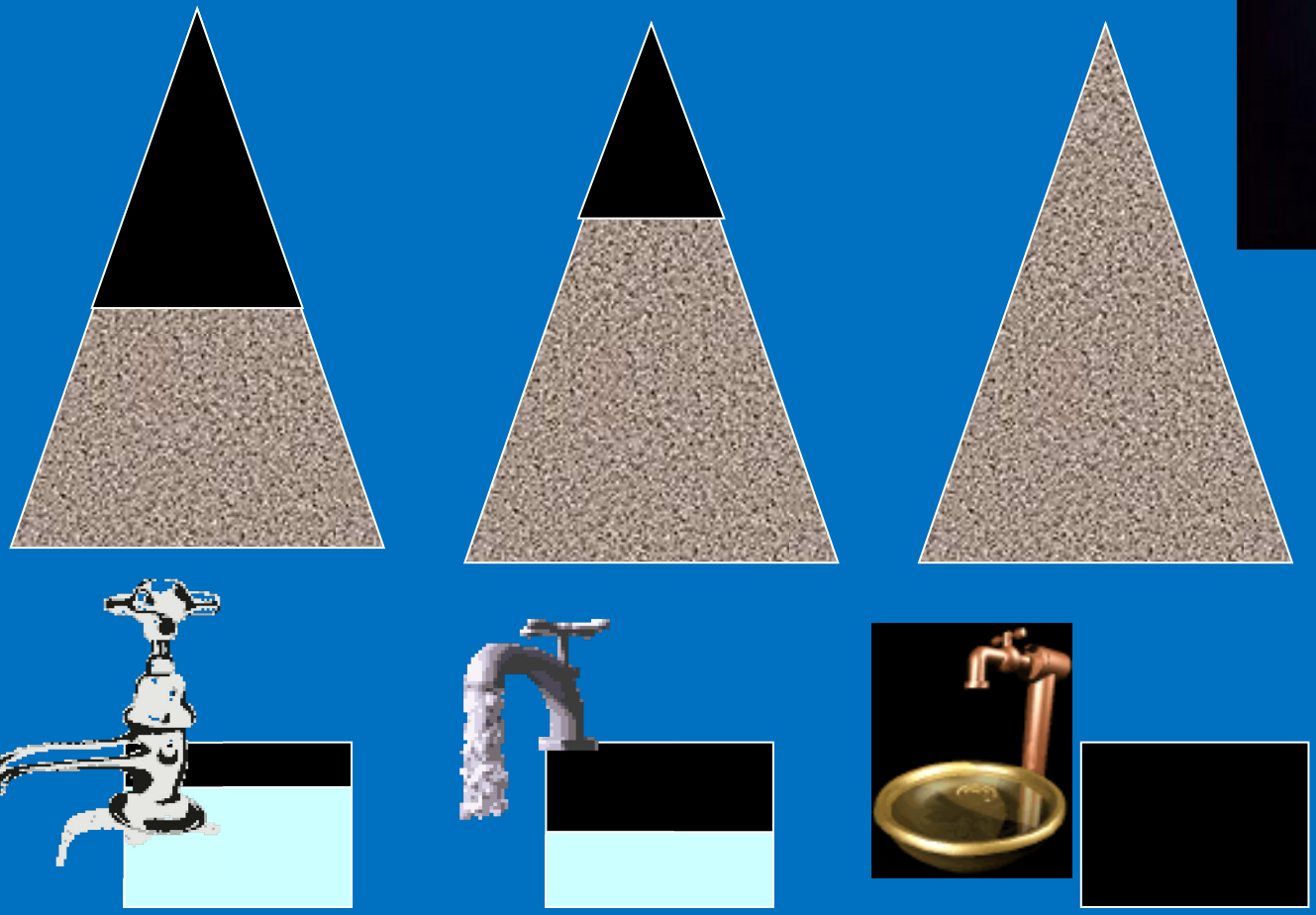


Illimani Basin

- Area: 59 km²
- Altitude: 6350 to 2500 m.o.s.l.
- Approx. 66km from La Paz, Bolivia
- Main ecological strata:
  - Highland Andean Puna, Pre-Puna and Upper valley.
- Main economic activities and water uses:
  - agriculture and livestock farming.
- Main course:
  - Sajhuaya River, tributary of La Paz River
- The basin encloses the communities of:
  - Khapi, Jalancha, Challasirca, Cebollullo, Cohoni, Chañurani, La Granja and Tahuapalca. Llujo and Pinaya because of their social interaction in the basin



Relation of Water availability of the glacier



Source: IHH-IRD

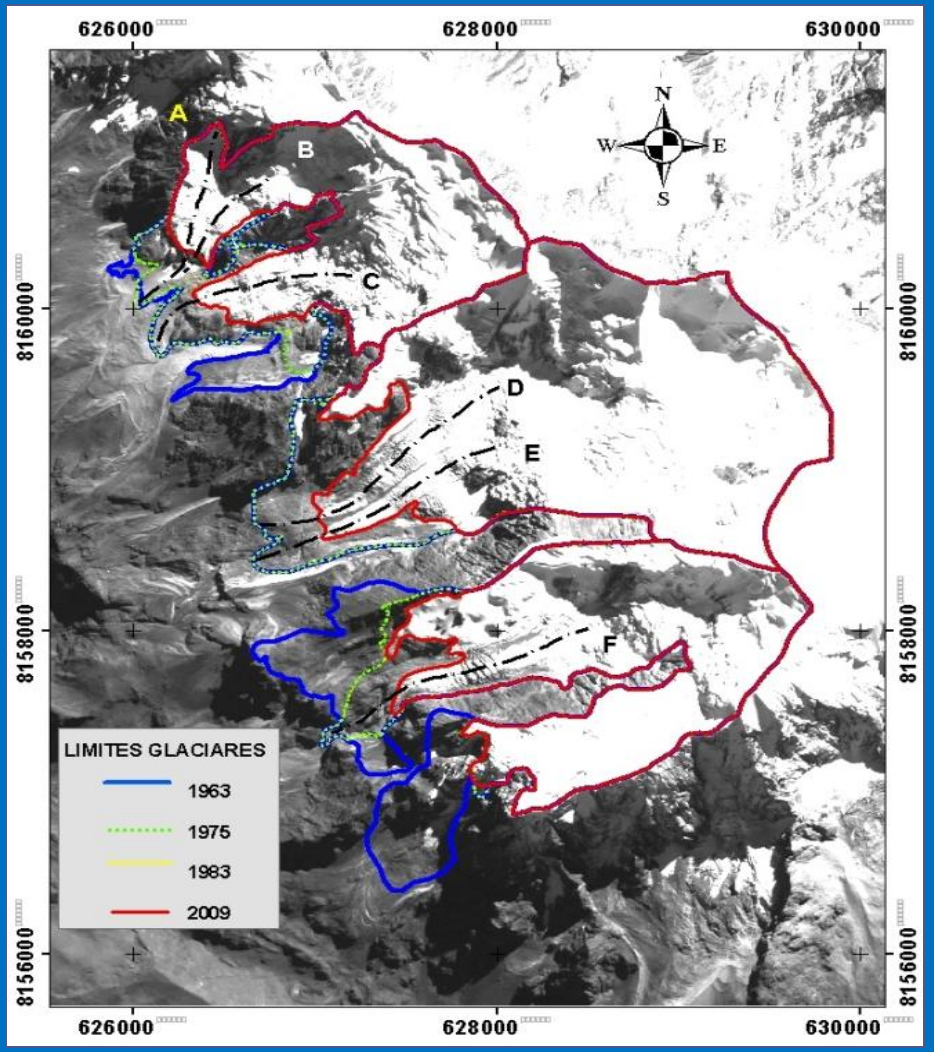
IHH-IRD

Glaciers retreat

- Aerial photos of the studied area, 60% overposed, for the years: 1963, 1975 y 1983 with scales 1:30000, 1:60000 and 1:50000, respectively.

- A present-day photogrammetric flight (July 2009).

- The contours of the Illimani Glacier (photogrammetric restitution).



Water rights mapping

Obtained information	Methology
Location of water sources	• Field georefeencing
Irrigation channels	• Field georeferencing
Crops location	• Satellital images (Google Earth, landsat) and interviews
Surfaces by crop	• Interviews to irrigation authorities. • Consistency analysis by: a) Comparison of obtained surfaces in satellital images b) Comparisson with data obtained from other studies
General information of rights, organization, management, etc.	• Interviews to stakeholders • Comunity workshops

Water rights mapping

Type of the right	Subject of the right	Expression of the right
Collective Right	Irrigation System	Discharge available in the river uptake. Remaining discharge after upstream systems took their part.
	Community	Period with available water in the community canal. During the rainy period it is available every day, during dry period only few days per week.
Individual Right	Family or person	Period with available water in the individual user's canal. Turns only during dry period. Free access on rainy season.

- Water availability
  - Enough water availability for present requirements during most of the year depending on the distribution rules. However, efficiency in distribution and irrigation very low
  - Erratic production pattern in most communities

- Tendency analysis
  - Clear upward tendency for temperature
  - Less clear reducing trend is appreciated for rainfall: no significance

Farmers' perception on climate change:

- Temperatures increase's perception is confirmed,
- Precipitations reduction's perception is not clear.
- Related/similar studies observed that the total precipitation amount is maintaining but its the temporal distribution is changing.

Productive vulnerability

- The improvement of road connections since 1985 increased the market integration.
  - Change to more intensive production (>3 harvests/year) of more profitable crops (eg. Lettuce)
    - compromises the sustainability of the systems:
      - is already reducing soils fertility and
      - increases the impact of crop plagues and diseases and
      - then increases the use of fertilizers and pesticides.

- The productive areas are expanding upwards
  - Possibility to cultivate fruits and other crops like maize due to increasing temperatures without management knowledge
  - stresses the irrigation systems operation because the water demand has increased a lot.

- Shift from agro-forestry to a completely agricultural system.

- Increasing important production losses' risk: reported by >80% population during 2008-2009 , causes: Plagues and diseases

Some autonomous adaptation strategies observed in the area

- Vertical spatial occupation at communal level: Each community has communal land over more than one ecological stratum.
  - Allows wide crops diversity and the survival of crops at least in one stratum during extreme weather conditions.
- Crop plots dispersion (at each ecological stratum): decreases the plagues and illness propagation.
- Soil conservation, to prevent soil erosion: small plots in very steep hills and bigger plots in less steep hills.
  - Terraces cultivation improves the retention and absorption of water.
- Aynoqas: constant crop rotation, prevents productivity reduction by monocropping

Implemented adaptation pilot projects

Conclusions

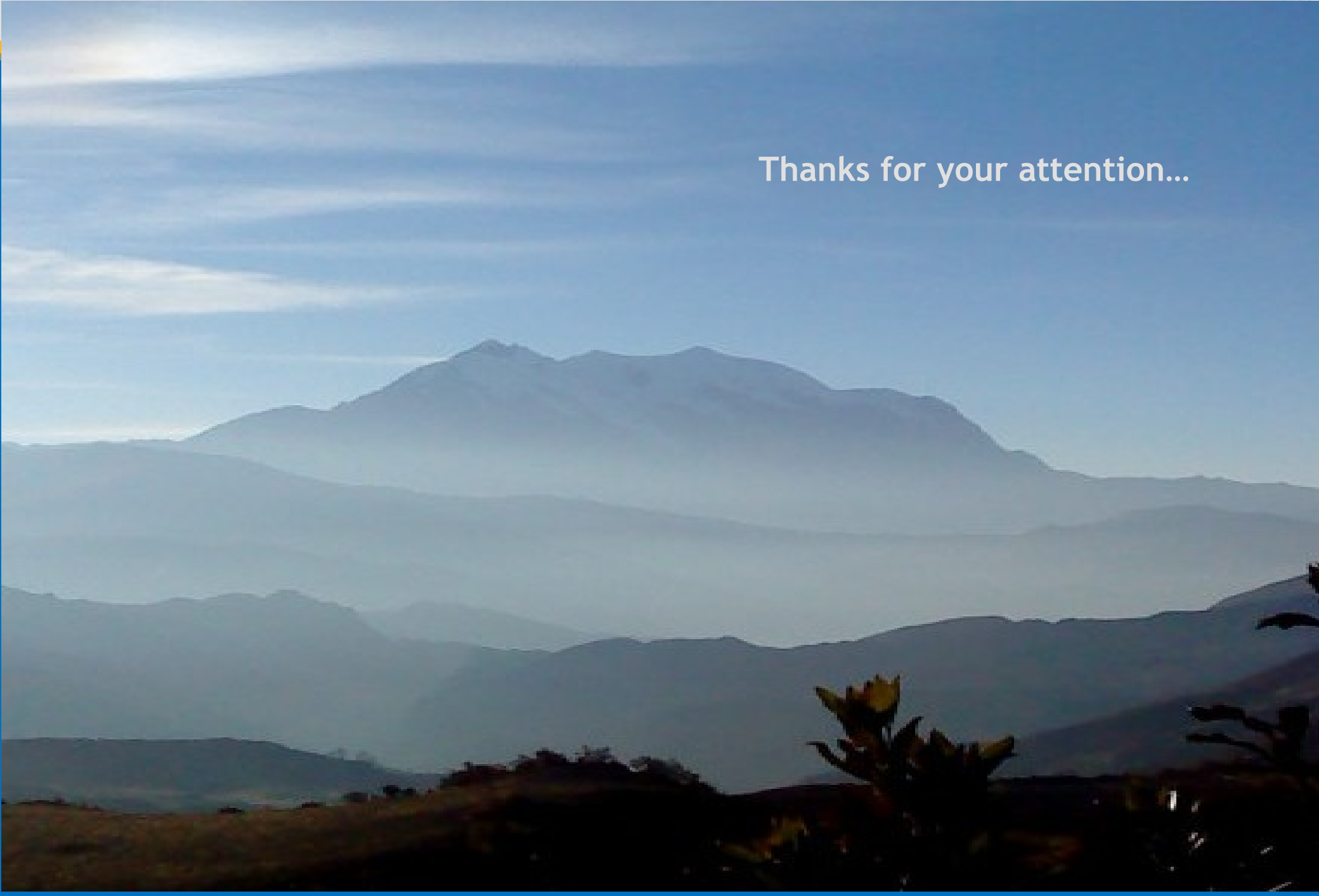
- The communities in the Illimani basin have a high degree of flexibility and potential adaptability to changes (uses and costumes) in the ecosystem and therefore to possible impacts of climate change.

- Illimani Glaciers had lost:
  - Approx. 21% of its area from 1963-2009, at 4.4 ha/year.
  - Loss in permanent snow thickness from 3.5m until even 35.6m, at average rates of loss between 7.7 and 77.4 cm/year.

- If the temperatures continue increasing and the rainfall patterns changing, the melting rate would become faster and devastating for the downstream people depending on its water resources.

Conclusions

- Due to the economical and institutional vulnerability, these fragile mountainous systems are very vulnerable to external impacts: climate change, surrounding socioeconomic and productive changes, contradiction within its operation rules.
  - Their institutional stability seems to weaken more in the future, which could hamper their adaptation possibilities.
- Some autonomous adaptation strategies to climate change are successfully being applied by these communities which should be replicated.
- To enforce the adaptability of agriculture in the studied area, integral actions must seek for:
  - the sustainability of the system,
  - improving the water and environmental management,
  - strengthening their institutional organizations and political incidence


Thanks for your attention…